# ● PRINTER RUSH ●
## (PTO ASSISTANCE)

**Application :** 09/713,242 **Examiner :** Mombleau **GAU :** 2878

**From:** DP **Location:** IDC FMF FDC **Date:** 12/1/05

Tracking #: EPM 09/713,242 Week Date: 9/5/2005

| DOC CODE | DOC DATE | MISCELLANEOUS |
|---|---|---|
| ☐ 1449 | | ☐ Continuing Data |
| ☐ IDS | | ☐ Foreign Priority |
| ☐ CLM | | ☐ Document Legibility |
| ☐ IIFW | | ☐ Fees |
| ☐ SRFW | | ☒ Other Let. 11/16/00 |
| ☐ DRW | | |
| ☐ OATH | | |
| ☐ 312 | | |
| ☒ SPEC | | |

[RUSH] **MESSAGE:** Specification pages No. 8 and 10 print Not clear. please provide cleared copy.

Thank you.

[XRUSH] **RESPONSE:** Done

**INITIALS:** [illegible]

NOTE: This form will be included as part of the official USPTO record, with the Response document coded as XRUSH.

REV 10/04

The selected population of an electron or hole level can also be achieved using continuous radiation (i.e. non-pulsed). If the photon source is irradiated with radiation corresponding to a particular transition energy within the quantum dot, the population of the quantum dot level can be controlled by periodically varying the transition energy of the quantum dot. This can be done in many ways, for example, the electric field across the dot may be varied by an applied AC voltage. Also, the carrier density of the dot or surrounding layers, the magnetic field applied to the quantum dot and even the temperature of the quantum dot can all be modulated to vary the transition energy of the quantum dot.

The transition energy of the quantum dot can be modulated so that the confined energy level is only capable of being populated by carriers for a certain time. This should be less than the relaxation time of the photoexcited electron-hole pair. Therefore, although the radiation intensity is constant, light can only be absorbed by the quantum dot for the short time that the transition energy equals radiation energy. The electron and hole can then recombine to emit a photon in the same way as described with reference to excitation by the pulsed laser. Sometime later, the transition energy of the quantum dot will be swept through the laser energy again and the dot is able to absorb an electron and hole again. Again, the degeneracy of the level may be lifted by application of a magnetic field or, a single electron may be introduced into the level by polarisation of the incident radiation. As before, the emitted radiation can be filtered to remove emitted light from the specific polarisation or to remove photons which arise due to recombination within other quantum dots.

Previously, the discussion has concentrated on illuminating the device in order to supply
~~Previously, the discussion has concentrated on illuminating the device in order to supply~~
carriers for the conduction valence band. However, the present invention may also operate by populating either of the conduction or valence bands by injection of carriers into the conduction or valence band level. In such a structure, in order to obtain fine control, it is preferable if either the conduction band levels or the valence levels are continually populated with excess carriers. The remainder of the discussion will concern a device where the valence band levels are populated with excess holes and

transition energy from dot to dot which may be due to fluctuations in the size or composition of the dots for instance. Thus, it is possible to selectively inject carriers into just one of the quantum dots.

In the above described device, this can be achieved by precise control of the voltage in the "ON" state. Alternatively, it may be possible to control the energy of the illuminating radiation to excite a transition in a single dot.

Preferably, the area of the source from which light is collected should contain, at most 1000 optically active quantum dots.

Once the photon is emitted from the quantum dot, it can be collected by an optical fibre. Preferably, the device is provided with a coupling means to allow the photons to be efficiently collected by a fibre optic cable. Such coupling means may comprise antireflection coating located on the surface of the device through which the emitted photons are collected. Also, the antireflection coating could be located on the optical fibre itself.

The coupling means may also comprise a lens to collect emitted photons.

A particularly preferable arrangement of the device is achieved if the source has a mirror cavity which has two mirrors located on opposing sides of the quantum dot. Preferably, one of the mirrors (ideally the mirror closest the output surface) is partially reflective such that it can transmit the emitted photons. More preferably, the energy of the cavity mode for said mirror cavity is preferably substantially equal to that of the emitted photons. Further, it is preferable if the distance between the two mirrors $L_{cav}$ of the cavity is defined by

$$L_{cav} = \frac{m\lambda}{2n_{cav}}$$